# QUARTERLY PROGRESS REPORT

**PREPARED FOR THE ALASKA ENERGY AUTHORITY**
**BY**
**CHENA POWER COMPANY**

**PROJECT TITLE:** Chena Power Geothermal Power Plant

**COVERING PERIOD:** April 1st through June 30th, 2006

**DATE OF REPORT:** July 14, 2006

**GRANT RECIPIENT:** Chena Power, LLC
P.O. Box 58740
Fairbanks, AK 99711

**AWARD NAME:** Alaska Energy Cost Reduction Solicitation

**AWARD AMOUNT:** $246,288

**PROJECT PARTNERS:** United Technologies Corporation
411 Silver Lane
East Hartford, CT 06108

**CONTACT(S):** Gwen Holdmann, Chena Hot Springs Resort
PO Box 58740
Fairbanks, AK 99711
office # (907) 451-8104; cell # (907)590-4577
*gwen@yourownpower.com*

**PROGRAM MANAGER:** Rebecca Garrett, Alaska Energy Authority
813 West Northern Lights Blvd
Anchorage, AK 99503

**PROJECT OBJECTIVE:**

The objective of this project is to install a 400kW Organic Rankine Cycle (ORC) geothermal power plant at Chena Hot Springs, Alaska. This will be the first power plant operated off fluid from a geothermal resource in the State of Alaska, and will serve as a demonstration of the technology in this state. Additionally, the geothermal power plant will replace a 200kW diesel Caterpillar genset, displacing $241,812 of diesel fuel annually[1].

[1] Based on April 2006 fuel cost of $2.48 per gallon, and current rate of use. This number has been revised upward since 2003 by 150%.

## EXECUTIVE SUMMARY

During the past Quarter, a substantial amount of progress has been made on the project, both at United Technologies and at Chena Hot Springs. Specific milestones accomplished during this Quarter include:

1. An additional 500 hour qualification test of the 1st unit at UTC in Hartford, CT prior to shipping the unit to Chena Hot Springs
2. Completion of the new power plant building and control room
3. Completion of Geothermal Production Well (Well #7)
4. Finalizing injection strategy
5. Building infiltration gallery and cold water pipeline
6. Installation of the hot water pipeline and hookup to power plant

This report will provide an update on each of these areas of focus, organized as Part 1-6.

The project is proceeding close to the original schedule, with installation of the first unit currently underway (July, 2006). The unit was delivered on July 8th, and a team for United Technologies is currently onsite to assemble the unit. According to the current installation schedule, power will be produced at Chena on August 7th, 2006.

The new production well at Chena was completed on July 5th to a depth of 700ft. The well was drilled a short distance from the existing TG9 on the far western edge of the geothermal field and exhibits the same temperature and pressure characteristics as that temperature gradient hole.

The project budget is on track from the previous Quarter, with a total project budget of $2,462,145. $1,381,126.58 was spent by Chena Hot Springs and Chena Power on the project during this report period, as a combination of in-kind and cash contributions.

## PART 1: 500 HOUR QUALIFICATION TEST

As previously reported, United Technologies Corporation (UTC), based in Hartford Connecticut, was selected as the manufacturer of the Chena Power system, using components from Carrier Refrigeration chillers. The power plant was built as two 200kW ORC modules at the UTC Research Center in Hartford, CT. The first unit was completed in early 2006, and underwent a 1000 hour qualification test period during January and February. The first round of qualification testing was completed with 99% availability of the unit. Performance testing has shown the unit will produced 230kW, which is 30kW more than design.

While the unit performed nearly flawlessly during the initial qualification period, once the unit was completely disassembled to look for any wear on components or internal problems a couple of minor issues were identified. Most significant was some impeller erosion, which was attributed to a failed filter at the impeller inlet. A new filter was installed to eliminate this problem. The unit was reassembled and underwent an additional 500 hour qualification test in April. Went the unit was disassembled the second time, no problems were observed with the unit. The unit was shipped June 15th and arrived at Chena Hot Springs via truck on July 8th.

A picture of the first ORC unit installed at Chena is included as ***Attachment A***.

**Figure 1.** ORC unit delivered to Chena Hot Springs July 8th

## PART 2: POWER PLANT BUILDING

In preparation for installation of the first ORC unit, a new power plant building has been constructed. The building is a pre-manufactured steel building which has been insulated with spray foam and painted. The power plant also contains a separate control room. The new building is adjacent to an existing maintenance equipment hanger and in close proximity to the current power plant, which will simplify hookup to existing electric infrastructure.

While the structure is complete and the control room installed, the geothermal heating, overheat garage doors, and some of the lighting has not been installed. Remaining items will be completed before the grand opening on August 20th.

**Figure 2.** ORC unit delivered to Power Plant building

## PART 3: COMPLETION OF PRODUCTION WELL

Initially, the primary production well was planned to be Well #6. However in early 2006 a very promising new site was discovered. An exploration hole, TG#9, was drilled to the far western edge of the field to a depth of 800ft. This well has shown potential for high flow rates from a 100ft zone between the depths of 450-550ft. A 10in diameter production well was drilled and completed to a depth of 700ft adjacent to TG9. Testing on the new well has shown that this new well can produce 1000gpm using a 40hp motor with an anticipated drawdown of 114ft. This is close to the predicted 90ft of drawdown reported in the last Quarterly update.

A report detailing testing to date on this production well was written by Dick Benoit and has been included as **Attachment B**.

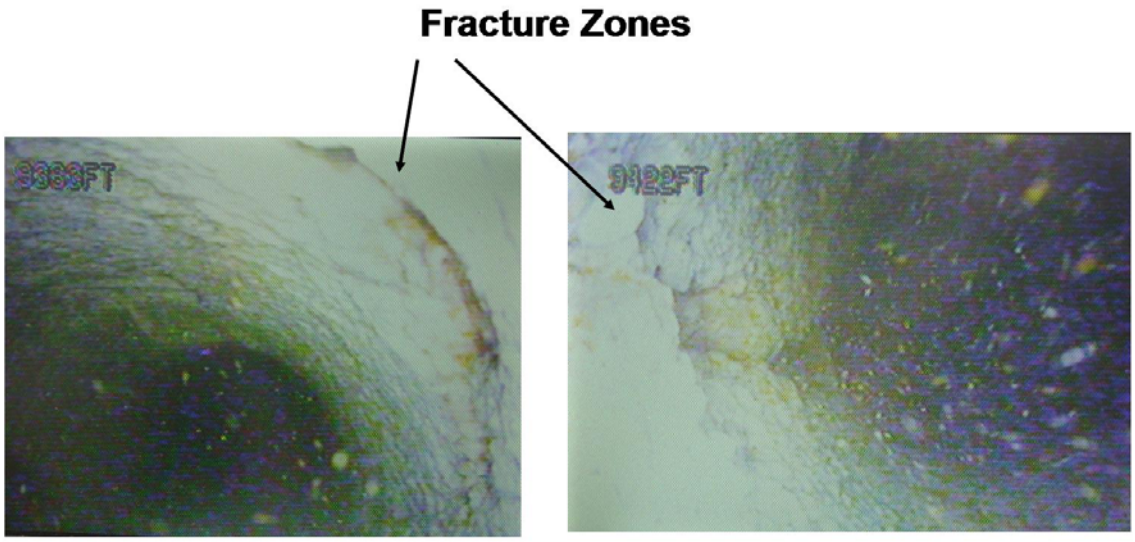



**Figure 3.** Fracture zones identified in Well#7. These fractures average 1-3in across and are generally steeply dipping vertical fractures with no apparent consistent angle or orientation. These images are from inside Well #7 at a depth of approximately 550ft.

## PART 4: FINALIZATION OF INJECTION STRATEGY

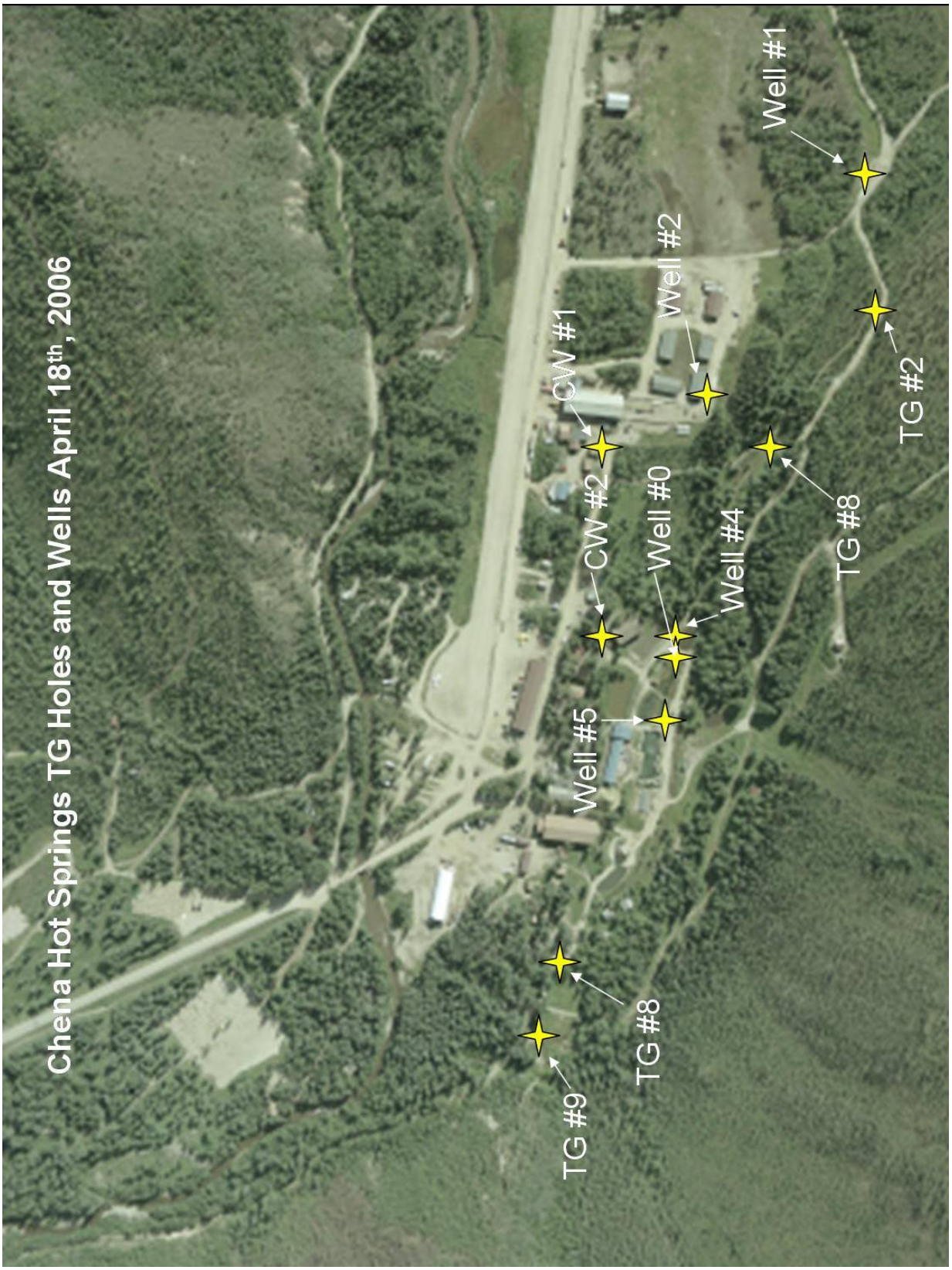
Developing a successful injection strategy is integral to the success of any large scale geothermal project. Chena has been working on characterizing its wells for nearly 2-1/2 years, largely in anticipation of minimizing the stresses placed on the reservoir due to this power generation project.

Initial injection candidates Well#1 and Well#2 were chosen primarily due to their distance from the proposed production area. However, additional testing during this Quarter has shown that while these wells are both unequivocally linked to the geothermal system/ reservoir, both have low injectivity indexes which make them poor candidates for injection of any substantial volume of fluid under the low wellhead pressures planned. In fact, further testing of Well#1 showed it was capable of drinking only 20-30gpm, and so it was eliminated as an injection site.

Well #2, cased to 300ft and open hole to 820ft will still be used for injection, but will be capable of drinking less than 100gpm. This well has been well characterized in terms of fracture zones. Information on lithography, completions, and fracture zones is included as **Attachment C**.

TG#7 will replace Well#1 as an injection well. This well was drilled to 702ft, and injection testing conducted in December 2005 indicate a very high injectivity index and that in all probability the well should be able to 'drink' at least 400gpm. A 4in liner hanging 20ft off the bottom of the well is currently restricting flow into the well. This liner will be removed and an additional high volume injection test will be conducted which will characterize the fracture zones in this well and show precisely where water is leaving the wellbore to insure the geothermal fluid is returning to the reservoir rather than mixing with the shallow groundwater.

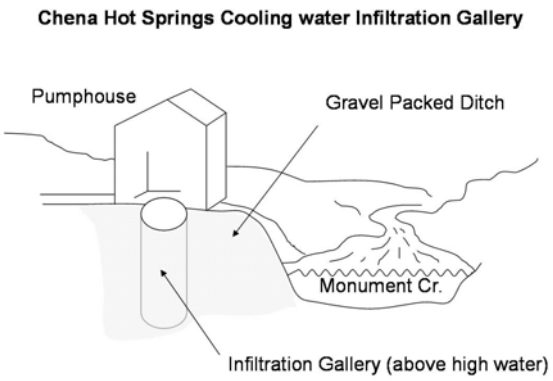
A map showing the locations of all the wells and TG (temperature gradient) holes at Chena is included on the following page.


Chena Hot Springs TG Holes and Wells April 18th, 2006
Well #1
Well #2
CW #1
CW #2
Well #0
Well #4
Well #5
TG #2
TG #8
TG #9
TG #8

## PART 5: INFILTRATION GALLERY AND COLD WATER PIPELINE

The cold water supply for the power plant condensers has been the portion of the project which has fallen somewhat behind schedule. This is due to a combination of design issues which needed to be addressed prior to obtaining DEC permission to construct, and more welding and pipeline preparation than was initially anticipated.

The power plant will be water cooled, and as such will require 1500gpm per unit of ~40°F water. Cold water will be supplied from an infiltration gallery located just to the east of the runway. The water will be supplied via a 16in buried and insulated steel pipeline, which will be buried on the northern edge of the runway. Discharge to Monument Creek will be through an existing drainage ditch which runs underneath the runway through a 24in culvert.




Permission to construct the infiltration gallery was obtained in September 2005, and a permit for wastewater discharge was submitted to DEC for review in March, 2006. Because new personnel were assigned to the project in the interim, additional questions were raised over the possibility for refrigerant contamination of Monument Creek. Additional safety measures and automatic shutdown procedures were installed to mitigate these concerns, which were approved by DEC in early July. Permission to complete the cold water pipeline installation was granted on July 12th, 2006, and the plant will operate under a temporary permit for the first 90 days until the final permit is issued in mid-August.

During this delay, work was ongoing in preparing and welding together sections of the 16in supply pipeline. The line will be installed in mid-July, along with the infilatration gallery.

A copy of the cold water permit submitted to DEC has been included as **Attachment D**.

## PART 6: INSTALLTION OF HOT WATER PIPELINE AND DESIGN OF HOOKUP TO POWER PLANT

The distribution system for both the cold and hot water supply and discharge systems have been designed for maximum flexibility. The hot water supply line for the power plant has been installed and extends approximately 2400ft from Well#7, past the main production well site Well#6, before turning north and reaching the power plant site. A spur line will connect to Well#6 to the main line in the future. All the known production zones are located within 200ft of the main line to allow maximum flexibility in production strategy. Fluid can be extracted from any or all well sites depending on long term reservoir reaction to the withdrawal of the fluid. Initially, water will be pumped from Well#7 using a 40hp submersible pump rated for the higher temperatures found in the Chena wells.

The pipeline was constructed from insulated 8in HDPE pipe follows an existing road which follows along the southern boundary of the property. The pipeline will be buried for most of its length once joints are pressure tested. The pipeline crosses Spring Creek two times adjacent to or on top of existing bridges.

**Figure 4.** Hot Water Pipeline Installation

**PROJECT BUDGET AND TIMELINE**

During the period from April 1st – July 10th covered by this report, $1,381,126.58 was spent on this project. Invoices were submitted to AEA on May 17th and June 28th. An additional invoice is being submitted with this report in the amount of $110,150. The final project costs are expected to come very close to the original budget. A summary of all invoices submitted to date (July 14th) is included as **Attachment E**.